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Comparison Of Marginal Seal Of MTA And Cyanoacrylate As Root End Filling Materials-An In Vitro Study.

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ABSTRACT

The aim of the present study was to compare the marginal seal between MTA Angelus and Cyanoacrylate when used as a root-end filling material. Thirty single-rooted maxillary central incisors were included as part of this study. Post the resection of the crowns cleaning and shaping with hand and protaper rotary files was done followed subsequently by obturation of the roots. The root ends were resected and root-end cavity preparation of 3 mm depth was performed using ultrasonic tips. Root samples were then randomized into 2 groups of 15 each and restored with (1) Group 1: MTA Angelus and (2) Group 2: Cyanoacrylate. Subsequently they are coated with 2 coats of nail varnish and immersed in Methylene blue dye 2% for 48 hrs followed by longitudinal root resection. Depth of dye penetration was evaluated under the stereomicroscope to examine the extent of microleakage in units of millimetres(mm). The results were then statistically analyzed using unpaired t test. Both the materials showed microleakage, however, MTA showed less microleakage with mean value of 1.3mm when compared to Cyanoacrylate at 1.6mm.

Keywords: Mineral trioxide aggregate -Angelus, Cyanoacrylate, Marginal seal, Dye leakage.

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INTRODUCTION

The complete elimination of microorganisms and the development of a fluid tight seal forms one of key contributors to a successful endodontic treatment [1,2]. Newer techniques and concepts along with the use of more efficient instrumentation and materials may not always result in resolution of periapical pathosis. In cases of failure with endodontic therapy, surgical treatment may be indicated [3].

The primary goal in apical resection is to perform a hermetic seal between the apical portion of the root canal and periapical tissues by a technique known as retrograde root end filling. The hermetic seal of a root end filling prevents the passage of microorganisms and their products into the tissues of periapical arena. Various materials have been used as root-end filling materials namely Gutta-percha, Silver amalgam, Super ethoxy benzoic acid, Cavit, intermediate restorative material, glass ionomers, Mineral Trioxide Aggregate (MTA) and newer material in Biodentine [6]. The ideal requisites for a root-end filling material include dimensionally stable, radiopaque, impermeable to tissue fluids, adhesive to dentin, non-absorbable, biocompatible and which promotes healing [4,5].

Variations in the anatomy of the apical third of root canals result in treatment failure. Therefore, it is necessary to eliminate the apical 3mm of the apex [7]. Additionally, the plane of sectioning the root is equally a key consideration in root resection technique. Inclined plane sectioning results in open dentinal tubules that can defer healing of the lesion. 90° angulations are highly acceptable for root resection with 3mm depth of penetration [8,9].

MTA has been proved to be one of the very reliable material of choice for root end filling. Cyanoacrylate exhibits good adhesion to bone even under moist conditions and used in oral surgery for wound closure. However, this adhesive has not been tested as a root end filling material after endodontic surgery, hence the key goal of this in-vitro study is to evaluate and compare the marginal seal of MTA and Cyanoacrylate when used as a root end filling material.

MATERIALS AND METHODS

Thirty extracted single rooted human maxillary central incisors were collected and used in this study. Disinfection protocol as given by Occupational Safety and Health Administration and Centers for Disease Control for disinfection of the extracted teeth was strictly followed.

All specimens were carefully examined with a dental operating microscope (OPMI Pico Dental Microscope, Carl Zeiss, Oberkochen, Germany) to rule out any teeth with root caries or restorations, open apices, fractures, cracks, or craze lines. Radiographs were taken to confirm the presence of a single canal without previous root canal treatment, resorptions, or calcifications. Ultrasonic cleaning to remove the soft tissue remnants and calculus was also performed.

The crowns of the teeth were sectioned at cemento-enamel junction with a diamond disc in a micromotor contra-angle hand piece. Endo-Z bur (Dentsply, Malleifer, Tulsa Dental, Tulsa, USA) was used to refine the endodontic access cavities and pulpal tissue was removed using a barbed broach (Dentsply, Iowa). Working length was determined by passing an ISO 15 K file into the root canal until the tip of the file was visible at the apical foramen, and then 1 mm was subtracted from that length. The teeth were instrumented to a size 25 hand file. Following this Protaper Universal rotary files (Dentsply) were used for instrumentation up to size 40. With irrigants being 17% EDTA and 5.25% sodium hypochlorite, Saline was used as a final rinse. Gutta-percha cone size 40/0.06 and AH plus sealer were used to obturate the canals and the access cavities being effectively sealed with restorative material of composite resin.

3mm of root resection was done at an angulation of 90° to the long axis of the tooth using a cross cut fissure bur. Ultrasonic tips (Zirconium nitride coated [KIS] retro tips: KiS-1D; US) were used to prepare cavities in the root-end to depth of 3 mm.

The teeth were randomly divided into two groups of 15 specimens each:

- Group I: MTA (MTA angelus – Angelus, Londrina, PR, Brazil).

- Group II: Cyanoacrylate (Dermabond – Ethicon Inc., Somerville, N.J)

Materials were mixed according to instructions by the manufacturer, and they were placed in the cavities at the root-end. Post completion of retrograde root filling procedure, teeth are coated with 3 layers of nail varnish except for the portion in apical arena. Subsequently teeth are allowed to dry for a period of 30 minutes. After the completion of drying period, teeth were placed in 2% methylene blue solution for a period of 48 hours. They are then washed and split longitudinally using diamond disc alongside a water coolant.

The depth of dye penetration is examined under the stereo-microscope to evaluate the roots for the extent of microleakage. The highest depth of dye penetration along one of the cavity walls is taken and measured using Motic Images Plus Software in units of millimeters. The acquired data are then statistically analyzed with unpaired t test.

RESULTS

Table 1: Depicts descriptive statistics of mean, standard deviation and unpaired t test

	N	Mean	Std. Deviation	Mean Difference	t	p	95% Confidence Interval of the Difference	
							Lower	Upper
MTA	10	1.40	0.14	-0.20	-2.372	0.029	-0.38	-0.02
Cyanoacrylate	10	1.60	0.23			sig		

Statistical analysis was done using unpaired t test; p value was 0.029 which was < 0.05; hence there was a statistically significant difference among the two groups at 95% of confidence interval.

According to the results, MTA showed less amount of dye penetration at 1.3mm and hence decreased microleakage compared to that of Cyanoacrylate at 1.6mm.

DISCUSSION

The key objective of any root canal treatment is the effective elimination of all kinds of microorganisms from the root canal system.

However, if conventional form of root canal treatment has failed due to various reasons, retreatment followed by Periapical surgery will most likely be necessary. Periapical surgery consists of apicotomy and retrograde root filling. Retrograde root filling is placed to establish an apical seal preventing the movement of microorganisms or their constituent products into peri-apical tissues. Apical seal is the single and the key factor in achieving success in field of surgical endodontics[10].

Clinical success, apical seal, handling properties, and biocompatibility are the various attributes which help in determining the choice of material for root-end filling.

MTA has been traditionally used as a material for root-end filling[11-14]. MTA has received increased interest due to its good biocompatibility and favourable tissue response. The limitations of MTA include its longer setting time and its handling properties that prevent it from being the ideal root end filling material [15].

The usage of Cyanoacrylate in the course of this study was due to the fact that it exhibits good adhesion to bone even in wet environments and polymerises in the presence of water. The initiator is already present in the bone and also on the surface, this enables Cyanoacrylate to polymerise and adhere to the surface[16]. Its proven good results and easy handling makes it another feasible option.

Ultrasonic tips were used for the root-end cavity preparation due to their good cutting ability, the cleanliness of root-end cavities, and reduced crack formation after root-end preparation[17].

Methylene blue dye was used to check the depth of penetration since it is the most commonly used dye and has proved to be important in several endodontic studies assessing microleakage [18].

Motic Image Plus Software was used for measurement of depth of dye penetration along the walls. The measurement was performed in units of millimeters. This software has the advantage of regional zoom, scale tools, advanced adjustments, white balance, and colour adjustment. Image analysis can make measurements with the added benefit for use of filters.

In the present study MTA showed better sealing ability than Cyanoacrylate [Reference: Table1] and the results showed a statistically significant difference between the 2 groups with a p value of 0.029. This may be due to the reason that MTA has a paste like consistency which allows the material to flow into the root end preparation and form a good seal. Improved MTA sealing ability is primarily due to its hydrophilic nature and slight setting expansion in the presence of water. MTA partially dissolves producing hydroxy appetite crystals which provides a mechanical seal by filling the microscopic spaces between MTA and the dentinal wall. However, Cyanoacrylate showed more microleakage which may be due to the polymerisation shrinkage which occurs during the setting of the material.

CONCLUSION

From the present study we conclude that both the materials showed microleakage when assessed under the microscope for dye penetration. However, MTA showed less microleakage when compared with Cyanoacrylate.

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